

Psychological understanding of Uncertainty

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State of the art in Decision-Sciences

Addressing:

1) How uncertainty in its different forms is or should be conceptualised and represented?

2) What tools are available to decision makers to manage this uncertainty?

How do decision scientists conceptualize uncertainty?

Decision Making Scenarios

(c)
Decision Making Scenarios



Outcomes and probabilities known



Unknown or unheeded
extreme events



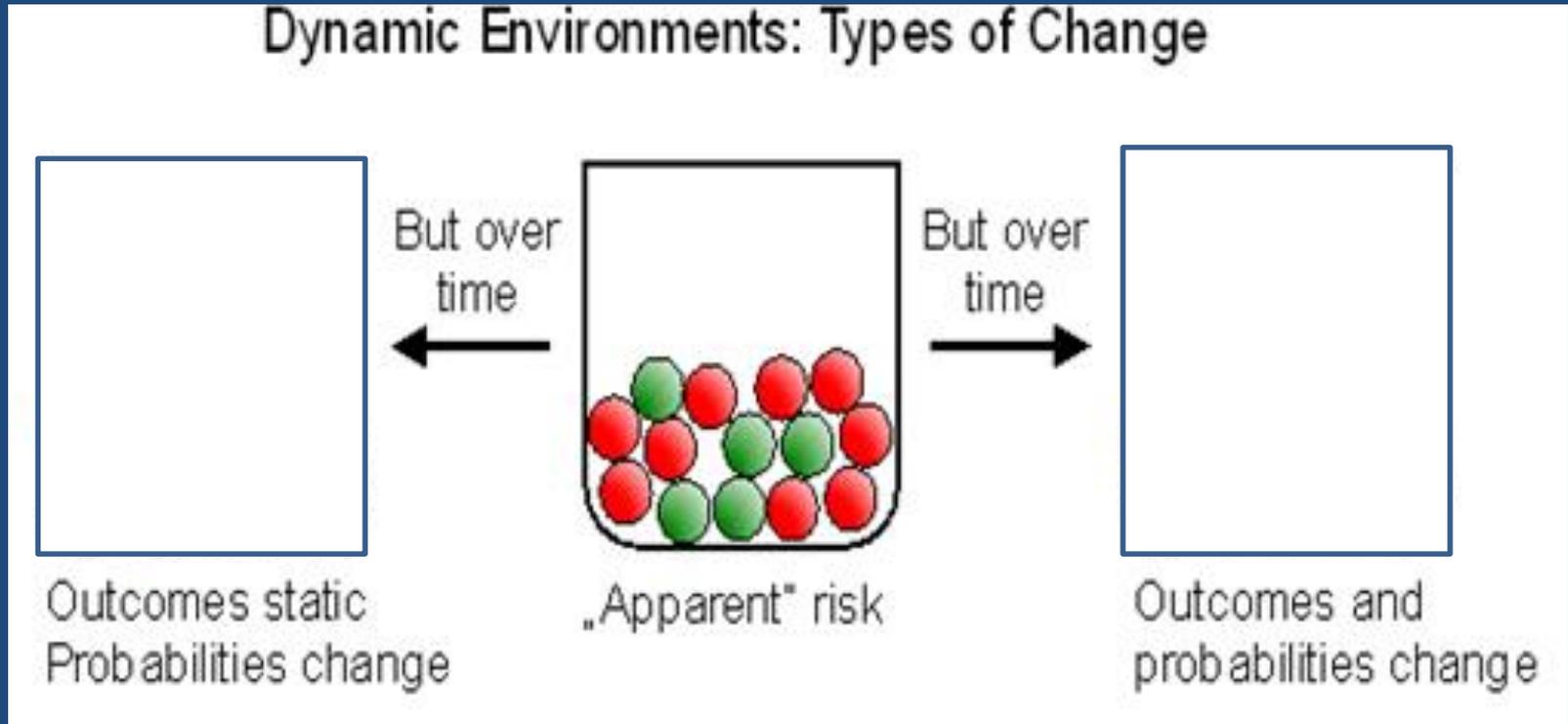
Outcomes known
Probabilities unknown



Outcomes unknown
Probabilities unknown

TRENDS in Cognitive Sciences

Dynamic uncertainty



How do decision scientists study dynamic uncertainty?

Methods for studying source of dynamic uncertainty

- Behavioural

naïve decision makers select actions to control outcomes in a “microworld”

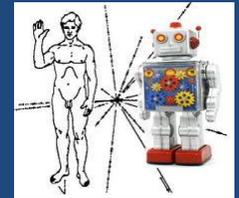


naïve decision makers select actions in simple choice tasks and patterns of brain activation are monitored.

- Neuroscientific

- Computational

formal models describe decision processes and determining optimal behaviour



- Applied



skilled decision makers behaviour is examined in “naturalistic decision making” situations (in the wild)

Behavioural Methods

- Mircoworlds – mini computerised situations that mimic uncertain domains in which the participant interacts with and then attempts to control various outcomes
 1. A brief Scenario is presented
 2. The participant is then shown the computer-based task
 3. They have a set number of trials in which to manipulate variables in order to control an outcome to criterion (under conditions of variable uncertainty)

Illustration: Early Lab Tasks

SUGARFACTORY



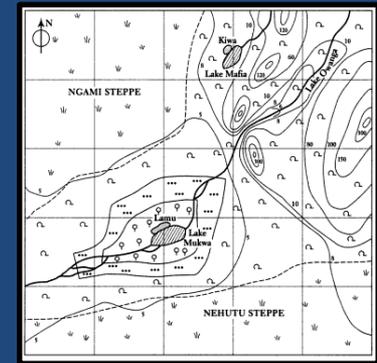
Berry & Broadbent (1984,
1987, 1988)

Fungus Eater



Toda (1962)

 **ecology**



Dörner (1975)

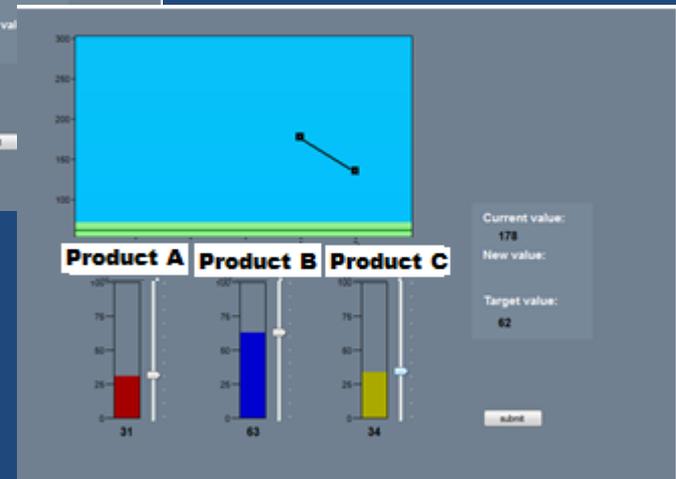
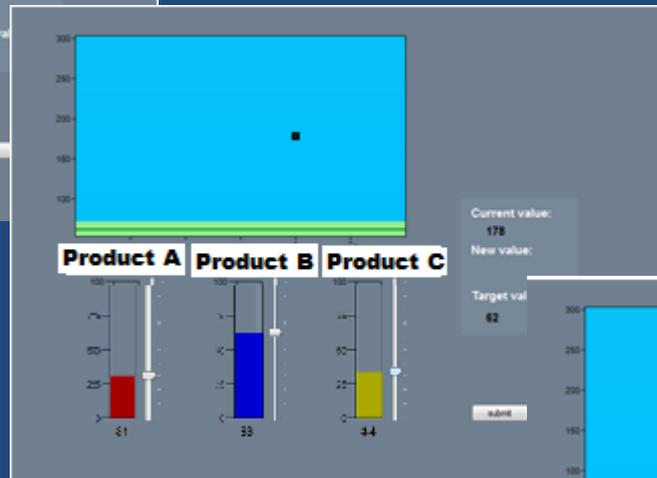
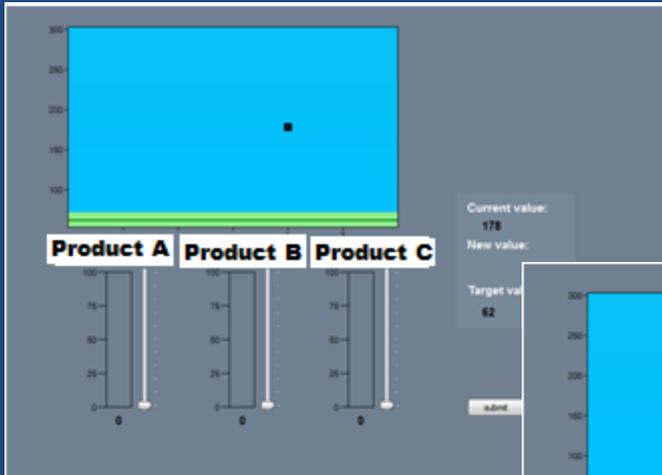


Omodei &
Wearing,
(1995)

Putz-Osterloh
(1981)



A Single trial



Research Programme of DLDM Lab

Some factors impacting our ability to manage dynamic uncertainty

Learning

- Mode of learning (**prediction vs. control**)
- Mode of goal (**specific vs. general**)
- Context (**Social/non-social**)

Dynamics

- Stability of the task environment (**Low, Medium, High**)

Motivators

- Feedback (**positive, negative, both, neither**)
- Financial Incentives (**Gains, Losses**)

Key Empirical Insights

Summary of core finding form Research Programme of DLDM Lab

Learning

- Mode of learning (**prediction vs. control**) 
- Mode of goal (**specific vs. general**) 
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Insights I

When presented with highly dynamically uncertain decision-making situations people....

1. **[learning]** ...are still able to learn to control a dynamically uncertain environment
2. **[strategies]** ...develop effective strategies to learn; though need ample exposure to the environment to do so, otherwise perseverate over poor strategies and fail to find successful alternatives.
3. **[rewards & feedback]** ...learn best when they are given frequent outcome feedback and non-ambiguous positive rewards for successful choices, social feedback cues/social rewards lead to increases in dynamic uncertainty.

Critical questions to be addressed

- What are the important questions and challenges?
- What are the main barriers to interdisciplinary work?
- What should funders be putting their money into?

What are the important questions and challenges?

Social Contexts

- Understanding dynamic uncertainty in social contexts
 - Decisions sciences fall short of developing good empirical methods for exploring complex social interactions in
 - Uncertain environments
 - Uncertain dynamic environment
 - Uncertain dynamic environments with different feedback/reward schedules

What are the barriers to interdisciplinary work?

Main Barriers

- Insight
 - There are many problems in society which cannot be fully addressed by one scientific discipline (Buanes & Jentoft, 2009)
 - Tame vs. wicked problems (Ritter and Weber, 1973)
- Attitude
 - While many academics surveyed are positively disposed to interdisciplinary work, many only pay lip service to it (Jakobson et al, 2004; Pellmer & Eisenberg, 2000)
- Structure
 - Conflicting signals from Institutions that encourage, but do not reward/acknowledge interdisciplinarity (Bruce et al, 2003)

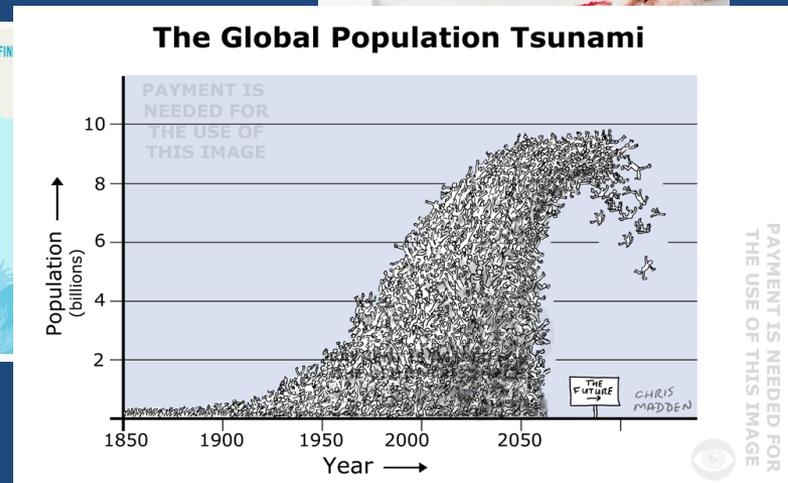
What should funders be putting their money into?

Investing in the right kind of question

A Case study: The global problem of Food Futures

Over the next few decades, the global food system will come under renewed pressure from the combined effects of eight key factors:

- population growth
- economic growth
- nutrition transition
- energy
- land
- water
- labour
- climate change (*for those that believe it*)



How do we best tackle Defensive Thinking: Psychological Barriers to Accepting Food Futures?

- Our sense of agency and responsibility for our actions are integrated on a fundamental level
- Reducing dynamic uncertainty depends successfully setting goals, and implementing actions designed to reach those goals
- Any external imposition on our choice behaviour, is perceived as a threat to our ability to control and therefore our sense of agency

Thanks to



**Maarten
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Hola**



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**Bjoern
Meder**



**Willian
Nelson**



Queen Mary
University of London



Illustration: Simple Real world Scenario

A Dynamically Uncertain decision-making scenario

Diagnostic
information:

Interventions



Blood Glucose
Sugar Diabetic
Monitor

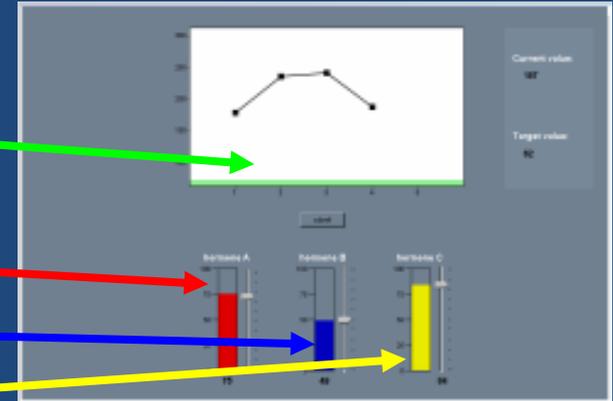


Structure of System

3 Cues , 1 Outcome (Continuous variables)

$$y(t) = y(t-1) + b_1 x_1(t) + b_2 x_2(t) + e_t$$

- **Outcome value** = $y(t)$
- Previous outcome value = $y(t-1)$
- **Positive cue** = $b_1 = 0.65$
- **Negative cue** = $b_2 = -0.65$
- (Null cue) Random noise = e_t



The random noise was drawn from a normal distribution with mean of 0, SD 4 (Low Noise), SD 8 (Intermediate Noise), SD 16 (High Noise), SD 32 (Very High Noise)